[redacted]

7 August 1964
WCT:bb:357
997-112

MEMORANDUM

To: [redacted] STATINTL STATINTL
From:
Subject: Intensity Stability of Laser Sources
CC: [redacted]
STATINTL

An investigation has been conducted of the stability of laser beam intensities. A survey of available literature, including periodicals, bibliographies, laser manufacturer's specifications, and a conversation with a representative of a laser manufacturer yielded very little information concerning the stability of laser beam intensities or the stability of the power supply output levels. Most manufacturers claimed that their lasers were maintenance free except for possible refilling of the gas tube. The gas tubes were all guaranteed against leakage for either 1000 hours STATINTL of operation or 1 year.

To obtain more information, a test was conducted using a [redacted] Model 112 Laser. The laser beam stability was investigated for continuous operating times up to 4 hours, while operating in three visible modes and at various power supply plate currents.

STATINTL The [redacted] Lab Model 200 RF Exciter which is used with the Model 112 Laser has a stated DC output regulation constant to .05% for line or load changes of ± 10%. This limit, however, does not answer the question of long term stability.

The laser beam was reduced in intensity by a piece of exposed film and then reflected into the micro-image scanner. The output of the micro-image scanner was recorded on the strip chart recorder in density units.

A number of tests were conducted. These included: (1) laser warmup, (2) mode stability, (3) range of stability, (4) recorder stability, and (5) long term stability.

(1) Laser Warm-up

After the recorder was warmed up, the laser was turned on. The laser power supply drifted from the initial plate current setting of 100 ma to 102 ma in 30 minutes. The recorder output had decreased .06 density units and was stable at the end of this time interval.

(2) Mode Stability

The three standing wave mode patterns tested were the TEM_{00}, TEM_{01}, and TEM_{02} modes. These modes were recognized by their characteristic patterns[1, 2] which appeared on the wall of the lab. All modes were stable over 5 minute intervals. The TEM_{02} mode had the highest intensity, hence all other tests were conducted in this mode.

(3) Range of Stability

After two hours of continuous laser operation, any change of the plate current setting , was followed by a drifting of the plate current. For plate currents less than 100 ma, and greater than 120 ma., the density readings were erratic and drifted continuously. In the plate current range 100 to 120 ma., stability was reached within 2 minutes.

(4) Recorder Stability

After one hour of running, it was noticed that turning off the chart and leaving the laser turned on produced discontinuous decreases of .02 density units when the chart was turned on again after 15 minutes. No such discontinuities appeared when this experiment was repeated with the micro-image scanner and the microdensitometer using an incandescent source. Therefore, it is concluded that these jumps were due to the drifting of the laser power, not the recorder.

(5) Long Term Stability

Although the density appeared constant over intervals of 5 minutes, long range drifting did occur. In two hours (after two hours of previous continuous running time) the density reading decreased .03 density units. A slightly increased plate current accounted for this change.

STATINTL STATINTL [redacted]

1 [redacted] Laser Technical Bulletin No. 1 Optical Properties of Lasers as Compared to Conventional Radiators June 1963

2 [redacted] Laser Technical Bulletin No. 2 Properties of Laser Radiators Giving Uniphase Wave Fronts August 1963